

REMARKS/CLARIFICATION

The specification has been amended editorially to clarify previously presented information and to correspond to clarifications requested in the office action. No new matter has been added. Included in this response is one marked, amended version of the original specification and one clean new version of the amended specification.

To clarify the description of the casing profile, "at least two side portions being closed on two ends to form at least one cavity," it has been changed to read "a first side portion and a second side portion, defining at least one space in between them."

The term "semi-rigid" has been replaced by "resilient" to more accurately describe the invention.

To further clarify the description, "cavity 18" has been replaced by "space 18".

Other minor grammatical corrections have also been made.

The Abstract has been amended to reflect the above mentioned corrections.

Claims 1-20 have been cancelled. New claims are submitted 21-57.

I respectfully request a timely notice of allowance be issued for this application.

Respectfully submitted,



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COMPOUND SPRING ELEMENT FOR A GAME RACKET

FIELD OF THE INVENTION

- 5 The present invention is intended for use on a game racket, in particular on a racket frame having strings held in tension and shaped to receive a compound spring element.

BACKGROUND INFORMATION

- 10 Reducing vibration and increasing the liveliness if the strings are well known themes in game racket design. Some of the most effective are those that simultaneously address these two issues at the connection between the strings and the head frame.
- 15 The game racket of U.S. Pat. No. 5,458,331 utilizes a fluid chamber to dampen shock and improve the string response. The racket head has an inner frame and an outer frame profile and the chamber is formed by the space in between. The game racket of U.S. Pat. No. 6,530,851 shows a similar use of an inner frame and a chamber defined by an outer frame that rests on the inner frame.
- 20 tension frame as it's called, is laced through with strings in tension to form an elastic connection with the inner frame.

- One inherent difficulty in both designs is that the chambers are defined on one side by the body of the inner head frame. This limits both the types of head
- 25 frame profiles that can be used and the possible locations for the chamber(s). It would be advantageous to have a chamber within a structurally independent unit to allow greater flexibility in designing and manufacturing. A second problem with the previous art, is that the string and or grommet penetrates and slides, piston like, through the chamber(s), making it difficult to maintain fluid pressure
- 30 without the use of a hose or bladder. It would be beneficial to have a structurally independent chamber that can withstand fluid pressure without the use of a hose or bladder.

ORIGINAL SPECIFICATION
WITH AMENDMENTS (MARKED)

Additionally, the range of elastic response to string tension in the tension frame of the game racket of U.S. Pat. No. 6,530,851 is limited by the minimal flexural capacity of the tension frame. The elastic response of the strings could be greatly enhanced by increasing the flexural capacity of the tension frame profile.

5 And lastly, in the previous art, the damping and/or elastomeric material within the chamber(s) and the outer profiles are separate pieces. It would be very convenient and efficient to have the damping and/or elastomeric elements be integral within a structurally independent unit.

10 One object of the present invention is to improve the playing quality of a game racket. Another object of the present invention is to unite the best qualities of a damping chamber and a tension frame in a structurally independent element which is easily manufactured and is variously position-able on the head frame profile. Another object is to attenuate impact shock and vibration. Another object
15 of the present invention is to improve the rebound towards a perimeter of the stringing and thus to expand the optimum hitting area.

Still another object is to provide a damped spring element which is adaptable to a wide range of frame profiles. Another object is to accommodate conventional
20 stringing standards while making it possible to affect the entire stringed surface. It is another object of the present invention to provide an efficient, structurally independent damped spring element which can be made separately from the frame if desired.

25 To achieve these objects, a compound spring element according to the present invention, is provided for a game racket frame. A resilient, ~~semi-rigid~~ casing forms the spring element, with its profile having a first side portion and at least at least a second side portion ~~two side portions~~ and defining being closed on at least two ends to form at least one space in between them ~~interior cavity~~. The at
30 least one space ~~at least one cavity~~ contains s at least one damping and/or elastomeric element which interacts with the casing to form a damped, compound structural unit that is flexurally resistant to string tension. It can be disposed in any number of advantageous positions on at least one part of a head frame to cooperate with at least one string.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 shows a simplified representation of a game racket for which the present invention is intended.

Figs. 2A and 2B show cross-sectional views corresponding to line 1-1 in Fig. 1 of a first embodiment of a compound spring element. Fig. 3A shows the element in one possible location nearer an outer facing surface of a simplified head frame profile. Fig. 2B shows the element holding a string in tension.

Fig. 3A and 3B are representations similar to Figs. 2A and 2B showing a second embodiment of the compound spring element disposed in alternative positions on a simplified representation of a head frame profile. Fig. 3A shows the spring element disposed nearer the midpoint of an opening in the head frame. Fig. 3B shows the element disposed nearer to the stringing within an opening in the head frame.

Fig. 4 shows a cross-sectional view along line 1-1 in Fig. 1 of another embodiment of the compound spring element disposed on a simplified representation of an alternate head frame profile.

Fig. 5 shows a cross-sectional view along line 1-1 in Fig. 1 of an alternate embodiment of the spring element disposed on a simplified representation of an alternate head frame profile.

Figs. 6A, 6B, 6C, and 6D show cross-sectional views of alternate embodiments of the compound spring element.

DETAILED DESCRIPTION OF THE INVENTION

According to a preferred embodiment , the present invention is intended for use with a typical game racket frame including a handle and a head frame holding a strings in tension. The present invention is a compound spring element for a game racket frame and is described herein. The components, including the element and the racket, may be lightweight and durable and can be composed of materials known to those having ordinary skill in the Art. Fiber-reinforced plastic and metal alloy for example, are suitable materials for the intended purpose.

Fig. 1 shows a simplified representation of a typical game racket frame 2 with a handle 4 and a head frame 6 holding the stringing 14 in tension. The typical cross-sectional view designated by line 1-1 in Fig. 1 is but one of many appropriate locations on a periphery of the stringing 14 for the compound spring element of the present invention.

Fig. 2A shows a cross-sectional view along line 1-1 of a first embodiment of a compound spring element 10 according to the present invention. The spring element 10 is shown disposed on a simplified representation of a head frame profile 8. Though there are a number of possible locations for the element 10, in this particular view, the spring element 10 is disposed in an opening 24 nearer to an outer facing surface 28 of the head frame profile 8. A profile of the resilient, semi-rigid casing 16 of the spring element 10 is depicted here with a closed profile and two side portions closed ends and defining defining one space cavity 18 in between and made of a suitable material such has fiber-reinforced plastic or metal or a combination thereof. Two damping and/or elastomeric elements 20 are shown within the space cavity 18, though more are possible, including at least one element 20 disposed between at least two holes 22 along a central axis defined by the stringing plane PR. The casing 16 and the space cavity 18 are penetrated by a hole 22 along the axis of the string plane PR. Fig. 2B illustrates the same embodiment of the spring element 10 holding a string 12 in tension. In this particular version, the string 12 is laced through to the outer facing surface 28 of the casing 16. Tension in the string 12 initiates a composite structural

interaction including the side portions of the resilient semi-rigid casing **16** and the elements **20** within the space cavity **18**. When the tension of the string **12** has increased for example, due to ball impact, the outer facing surface **28** of the casing deflects, compressing the space cavity **18** and prompting the opposite side of the casing **16** to resist the increased pressure. The result is a damped, flexible response that alleviates increased ~~decreases the~~ string **12** tension upon ball impact for added dwell time, and subsequently accelerates an increase in string **12** tension as the spring element returns to its original shape, and the ball is propelled from the string **12**. The elastic capacity of the compound spring element **10** and the play of the racket **2** generally, is greatly enhanced by the synchronized relationship of the resilient semi-resilient casing **16** and the element(s) **20** in the space cavity **18**. The parts unite structurally to achieve a semi-rigid state having both flexural resistance and damping properties.

Fig. **3A** and **3B** show cross sectional views along line 1-1 in Fig. **1** of a second embodiment of the present invention in a simplified representation of a head frame profile **8**. The spring element **10** is located nearer to the midpoint within an opening **24**. A hole **22** penetrates the resilient semi-rigid casing **16** on the axis of the stringing plane **PR**. Fig. **3B** shows the second embodiment of the spring element **10** disposed within an opening **24** in the head frame profile **8** that is nearer to its inner facing surface **30**.

Fig. **4** shows a cross-sectional view of a third embodiment of the compound spring element **10** according to the present invention. In this view of a simplified representation of a head frame profile **8**, the casing **16** is disposed in a groove or indentation **26** on the outer facing surface **28** of the profile **8**. In this particular embodiment, the profile of the casing **16** demonstrates the use of at least one recess **36** for the damping and/or elastomeric elements **20**. This embodiment also requires that the inner facing surface **30** of the casing **16** has appropriate clearance from the head frame profile **8** to allow unrestricted deflection. A hole **22** in the element **10** has a corresponding hole **22** in the head frame profile **8** through which to receive a string **12** in tension; along the axis of the string plane **PR**.

Fig. 5 is a cross-sectional view depicting a fourth alternate embodiment of the compound spring element 10 of the present invention. An outer facing surface 28 of the casing 16 penetrates through to its opposite side, forming a support member for the hole 22 and continues into the opening 24 of the simplified head frame profile 8. For ease of stringing, this particular embodiment of the spring element 10 allows the knot on the string to occur nearer the inner facing surface 30 of the profile 8. The damping and/or elastomeric element(s) 20 are shown contained within the space cavity 18 on either side of the stringing plane PR, but could also be disposed between at least two holes 22 along a central axis defined by PR.

Figs. 6A, 6B, 6C, and 6D are cross-sectional views illustrating other possible embodiments of the compound spring element 10 according to the present invention. The casing 16 of the particular embodiments described here are all made of a suitable, resilient, ~~semi-rigid~~ material such as fiber-reinforced plastic or metal or a combination thereof. The spring element 10 of Fig. 6A has an interior space cavity 18. The space cavity 18 is further divided by at least one resilient semi-rigid wall section to form a fluid tight space cavity 18 on either side of the stringing plane PR. The central space 18 cavity is penetrated by the hole 22 along the axis of the stringing plane PR to receive a string in tension. This particular embodiment could also be formed without the central space cavity 18.

Fig. 6B shows the space cavity 18 defined by the resilient semi-rigid casing 16, and containing a number of damping and/or elastomeric elements 20. A hole 22 is provided to lace the string 12 through the outer facing surface 28 of the casing 16. Fig. 6C shows a damped spring element 10 with the resilient semi-rigid casing 16 having more than one space cavity 18. The space(s) cavity(s) 18 are formed by at least one internal wall section of resilient semi-rigid material, spanning from one closed end of the spring element 10 to a second closed end, and containing multiple damping and /or elastomeric elements 20. A hole 22 in line with the axis of the string plane PR is provided for the lacing of the string 12. The casing 16 of the spring element 10 in Fig. 6D defines a space cavity 18. The

space cavity 18 is further divided by a resilient semi-rigid wall section to form a fluid tight space cavity 18 on either side of the stringing plane PR. The centrally located space cavity 18 receives a connecting aperture 32 with an eyelet 34 through which the string 12 is laced. The space(s) cavity(s) 18 in this fluid tight arrangement are capable of holding at least one damping and/or elastomeric element 20 such as a liquid, gas or vapor under pressure without the use of a hose or bladder.

The improved flexural capacity of the compound spring element 10 of the present invention results from the unified structural response of its parts to a string 12 in tension. The physical properties of the parts and how they interact determine the performance qualities of the element 10. It must be rigid enough to hold the string in tension, yet flexible enough to deflect in response to minimal increases in tension brought on by ball impact.

The profile of the casing 16 can be formed into a variety of shapes, each with different flex points and having distinctive reactions to deformation. Though the at least two side portions of the casing 16 are shown having complimentary curvatures, there are a number of other variations that would make structural sense. At least one side portion could be flat while at least another is curved. The curvatures could be concave or convex or reversed to face away from the stringing 14. The side portions of the casing 16 also can have bends which serve as flex points and/or recesses 36 to receive at least one damping and/or elastomeric elements 20.

The composition of the ~~semi-rigid~~, resilient material of the casing 16 is also critical to the behavior of the spring element 10. A suitable material such as fiber-reinforced plastic or aluminum, should be lightweight, resilient, and have the capacity for fabrication in varying thicknesses.

The characteristics of the damping and/or elastomeric elements 20 and the nature of their interaction with the casing 16 are also critical in determining the response properties of the compound spring element 10 of the present invention.

In a preferred embodiment, the at least one element **20** within the at least one space cavity 18 has both damping and elastic properties. The internal element(s) **20** can be for example, of an elastic material such as silicone, and are, e.g., corresponding lengths of a profile, for example a profile made of this material with a circular cross section.

The elements(s) **20** can also be hoses or tubes, for example, that are filled with a liquid or gas or air and are tightly sealed within the at least one space internal cavity 18 of the compound spring element **10**. The hoses can be pressurized to a particular chosen pressure during the assembly or remain non-pressurized until tensioning of the strings **12** occurs. Other alternative embodiments have been illustrated herein which show that a fluid tight space cavity 18 can be formed by avoiding its penetration by a through hole **22** and/or a string **12**. The composite flexural response of the spring element **10** in this case is due in part on the pressure within the ~~at least one~~ space cavity 18.

A wide range of flexural responses can be achieved by varying both the casing **16** material and shape, and the internal damping and/or elastomeric elements **20**. In one preferred embodiment, the response is greatly enhanced when the at least one space cavity 18 is filled with a fluid medium, particularly if the medium is enclosed in continuous loop around the periphery of the stringing **14**. In this case, the state of equilibrium allows substantial numbers of adjacent strings to respond accordingly with increased tension to a concentration of forces on a small area of the strings due to ball impact.

The compound spring element **10** according to the present invention can engage the head frame **16** periphery of a game racket **2** in any number of appropriate locations. In one embodiment, the element **10** is a singular structurally independent unit cooperating with at least one string or it can be a multiple of elements **10** connected to form small segments and disposed on the head frame **16** to cooperate with portions of the stringing **14**. In another preferred embodiment the element **10** is formed as a long continuous rail- like element to fit around the entire periphery of the head frame **6**. The spring element **10** is

adaptable to any size or shape of game racket and it can be made separately and installed during or after fabrication of the racket.

The head frame profile(s) **8** illustrated herein are simplified representations intended for reference only. There is great flexibility in requirements for the design of profile **8**. The spring element **10** requires that the profile **8** provide a bearing surface facing away from the stringing **14**, ~~for each of its at least two ends~~. The head frame profile **8** should be generally wider than the element **10** and provide through holes and/or openings for the string(s) **12** to pass through.

Lastly, the profile **8** should provide clearance for lateral flexion, in a direction perpendicular to and away from, the stringing plane **PR**, of the ~~at least two ends edges~~ of the spring element **10**. Because the compound spring element **10** includes contains at least one space cavity **18** within a structurally independent unit, it's adaptable to a wide variety of head frame profiles designs. The element **10** can be disposed to span an opening in the frame as in Figs. **2A** and **2B**, Figs. **3A** and **3B**, and Fig. **5** or it can rest in an indentation **26** on the head frame profile **8** as in Fig. **4**. Other variations are possible and will become apparent to those skilled in the art.

Although the foregoing invention has been described in terms of certain preferred embodiments, other preferred embodiments will become apparent to those of ordinary skill in the art in view of the disclosure herein. Accordingly, the present invention is not intended to be limited by the recitation of embodiments, but is intended to be defined by reference to the appended claims.

ABSTRACT OF THE DISCLOSURE

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A compound spring element for a game racket frame is provided. A resilient, ~~semi-rigid~~ casing forms the spring element, with its profile having a first side portion and at least a second side portion ~~two side portions~~ defining at least one space in between them. ~~and being closed on at least two ends to form at least~~
10 ~~one interior cavity.~~ The at least one space cavity contains at least one damping and/or tension ~~elastomeric~~ element which interacts with the casing to form a semi-rigid, damped, compound structural unit that is flexurally resistant to string tension. It can be disposed in any number of advantageous positions on at least one part of a head frame to cooperate with at least one string.

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